I claim:

1. In a CPAP apparatus having an electric motor, an impeller rotated by the motor, a patient interface, an air delivery conduit for delivering air from the impeller to the patient interface, a sensor for determining the pressure in the patient interface, and a control mechanism that causes air to be delivered at a desired pressure to the patient interface, and that detects transitions between inhalation and exhalation of a respiratory cycle of a patient; a method of controlling the motor operation comprising the steps of:

controlling the interface pressure to rapidly drop at the start of expiration by an expiratory relief pressure (ERP) that is independent of instantaneous respiratory flow, and

then gradually controlling the pressure to rise to an inspiratory level at or shortly before the end of expiration, or at the onset of an expiratory pause, if any,

said ERP being a function of the inspiratory pressure.

2. A method in accordance with claim 1 wherein the ERP is an increasing function of the inspiratory pressure.

3. A method in accordance with claim 2 wherein for low inspiratory pressures the ERP is zero and for high inspiratory pressures the ERP has a maximum value.

4. A method in accordance with claim 2 wherein the expiratory pressure follows a template that is a function of the expected expiration time, the magnitude of the template being equal to said ERP.

5. A method in accordance with claim 4 wherein the instantaneous pressure during expiration is controlled by determining the current estimated proportion of expiration and calculating therefrom and from said template the proportion of ERP to be delivered.

6. A method in accordance with claim 5 wherein the current estimated proportion of expiration is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations measured for a number of the preceding breaths.

7. A method in accordance with claim 4 wherein the instantaneous pressure during expiration is controlled by determining the current estimated proportion of expiration before an expiratory pause and calculating therefrom and from said template the proportion of ERP to be delivered.

8. A method in accordance with claim 7 wherein the current estimated proportion of expiration before an expiratory pause is determined by comparing the expiration time of the

breath in progress to low-pass filtered expiratory durations before an expiratory pause measured for a number of the preceding breaths.

9. A method in accordance with claim 1 wherein the instantaneous pressure during expiration is controlled by determining the current estimated proportion of expiration and basing thereon the proportion of ERP to be delivered.

10. A method in accordance with claim 9 wherein the current estimated proportion of expiration is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations measured for a number of the preceding breaths.

11. A method in accordance with claim 9 wherein the flow during expiration is measured and if it reaches a small negative threshold that is too low for the current estimated proportion of expiration, then the pressure is ramped rapidly up to an inspiratory level.

12. A method in accordance with claim 1 wherein the instantaneous pressure during expiration is controlled by determining the current estimated proportion of expiration before an expiratory pause and basing thereon the proportion of ERP to be delivered.

13. A method in accordance with claim 12 wherein the current estimated proportion of expiration before an expiratory pause is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations before an expiratory pause measured for a number of the preceding breaths.

14. A method in accordance with claim 12 wherein the current estimated proportion of expiration before an expiratory pause is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations before an expiratory pause determined for a number of the preceding breaths by using fuzzy logic.

15. A method in accordance with claim 12 wherein the flow during expiration is measured and if it reaches a small negative threshold that is too low for the current estimated proportion of expiration, then the pressure is ramped rapidly up to an inspiratory level.

16. In a CPAP apparatus having an electric motor, an impeller rotated by the motor, a patient interface, an air delivery conduit for delivering air from the impeller to the patient interface, a sensor for determining the pressure in the patient interface, and a control mechanism that causes air to be delivered at a desired pressure to the patient interface, and that detects transitions between inhalation and exhalation of a respiratory cycle of a patient; a method of controlling the motor operation comprising the steps of:

controlling the interface pressure to drop at the start of expiration by an expiratory relief pressure (ERP), and

then controlling the pressure to rise to an inspiratory level at or shortly before the end of expiration, or at the onset of an expiratory pause, if any,

wherein the expiratory pressure follows a template that is a function of the expected expiration time.

17. A method in accordance with claim 16 wherein the instantaneous pressure during expiration is controlled by determining the current estimated proportion of expiration and calculating therefrom and from said template the proportion of ERP to be delivered.

18. A method in accordance with claim 17 wherein the current estimated proportion of expiration is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations measured for a number of the preceding breaths.

19. A method in accordance with claim 16 wherein the instantaneous pressure during expiration is controlled by determining the current estimated proportion of expiration before an expiratory pause and calculating therefrom and from said template the proportion of ERP to be delivered.

20. A method in accordance with claim 19 wherein the current estimated proportion of expiration before an expiratory pause is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations before an expiratory pause measured for a number of the preceding breaths.

21. A method in accordance with claim 16 wherein the instantaneous pressure during expiration is controlled by determining the current estimated proportion of expiration and basing thereon the proportion of ERP to be delivered.

22. A method in accordance with claim 21 wherein the current estimated proportion of expiration is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations measured for a number of the preceding breaths.

23. A method in accordance with claim 21 wherein the flow during expiration is measured and if it reaches a small negative threshold that is too low for the current estimated proportion of expiration, then the pressure is ramped rapidly up to an inspiratory level.

24. A method in accordance with claim 16 wherein the instantaneous pressure during expiration is controlled by determining the current estimated proportion of expiration before an expiratory pause and basing thereon the proportion of ERP to be delivered.

25. A method in accordance with claim 24 wherein the current estimated proportion of expiration before an expiratory pause is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations before an expiratory pause measured for a number of the preceding breaths.

26. A method in accordance with claim 24 wherein the current estimated proportion of expiration before an expiratory pause is determined by comparing the expiration time of the breath in progress to low-pass filtered expiratory durations before an expiratory pause determined for a number of the preceding breaths by using fuzzy logic.

27. A method in accordance with claim 24 wherein the flow during expiration is measured and if it reaches a small negative threshold that is too low for the current estimated proportion of expiration, then the pressure is ramped rapidly up to an inspiratory level.

28. A method in accordance with claim 16 wherein the ERP is a function of the inspiratory pressure.

29. A method in accordance with claim 28 wherein the ERP is an increasing function of the inspiratory pressure.

30. A method in accordance with claim 28 wherein for inspiratory pressures between a first value and a second value, the ERP is linearly dependent upon the inspiratory pressure.

31. A method in accordance with claim 30 wherein the first value is about 4 cmH_2O.

32. A method in accordance with claim 30 wherein the second value is about 12 cmH_2O.

33. A method of determining the expiratory proportion of a breath, p, comprising the steps of:

monitoring a respiratory flow of air of a patient;

calculating an expected duration of expiration, d, from at least one prior breath from said respiratory flow;

determining the start of exhalation of the patient within the breath;

calculating a time, t, since the start of exhalation of the patient; and

calculating p from the ratio of t and d.

34. A method in accordance with claim 33 wherein the expected duration of a breath is calculated by low pass filtering a time series of prior expiratory durations.

35. A method in accordance with claim 34 wherein the low pass filter is an Infinite Impulse Response (IIR) filter.

36. A method in accordance with claim 35 wherein the IIR filter is first-order.

37. A method in accordance with claim 33 wherein the expected expiratory duration, d_{m+1}, of the (m+1)th breath is calculated from the duration of the current breath d_m, the previous breath d_{m-1} and a constant k in accordance with the following equation:

$$d_{m+1} = k\, d_m + (1-k)\, d_{m-1}$$

38. A method in accordance with claim 34 or 35, wherein a low pass filter update $T_{exp,LPF,m}$, being the expected expiratory duration to be used for the next breath, is calculated by the following equation:

$$T_{\exp,LPF,m} = kT_{\exp,m} + (1-k)T_{\exp,LPF,m-1}$$

where k is a constant, $T_{\exp,m}$ is the expiratory duration measured for the current breath m, and $T_{\exp,LPF,m-1}$ is the previous filter update calculated for the preceding breath.

39. A method in accordance with claim 37 or 38 wherein the constant k is generally in the range of 0.1 to 0.2.

40. A method in accordance with claim 33 wherein the expected duration of a breath is calculated using a median filter.

41. A method in accordance with claim 40 wherein the median filter has a length in the range of 5 to 7 elements.

42. A method of detecting an expiratory pause in a breath comprising the steps of:

continuously calculating a flow signal indicative of a respiratory flow of air to a patient;

determining whether the flow signal is an expiratory flow signal;

determining that an expiratory pause has commenced when expiratory flow signal exceeds a small negative threshold;

43. A method as claimed in claim 42 wherein the flow signal is filtered

44. A method as claimed in claim 43 wherein the filter is a low pass filter with a low -3 dB point of approximately 5 Hz.

45. A method as claimed in claim 42 wherein the small negative threshold is about -0.07 l/sec.

46. A method as claimed in claim 43 wherein the filter is a time-symmetrical Finite Impulse Response (FIR) filter.

47. A method of determining the duration of an expiratory pause comprising the step of determining the duration of the longest contiguous period ending at the end of expiration such that the respiratory flow during that period does not lie outside a range of values which represents small flow.

48. A method as claimed in claim 47 wherein the range of values is generally from -0.7 l/sec to +0.7 l/sec.

49. A method of determining the expiratory pause fraction of a breath, k, comprising the steps of:

continuously calculating a flow signal indicative of a respiratory flow of air to a patient;

calculating a rate of change of said flow signal;

determining a fuzzy extent to which the flow signal is indicative of an expiratory pause from said flow and rate;

calculating a value F from low pass filtering said fuzzy extent; and

calculating the expiratory pause fraction, k, from the equation:

$k = 1 - F$.

50. A method as claimed claim 49 wherein the fuzzy extent to which the flow signal is indicative of an expiratory pause is calculated in accordance with the fuzzy rule that if the flow signal is zero and the rate of change of the flow signal is steady then the fuzzy phase is expiratory pause.

51. A method as claimed in claim 49 wherein the low pass filter has the property that it is only updated during expiration.

52. A method as claimed in claim 49 wherein the low pass filter is a first order low pass filter.

53. A method as claimed in claim 49 wherein the low pass filter has a time constant of approximately four times the long-term average of the respiratory period.